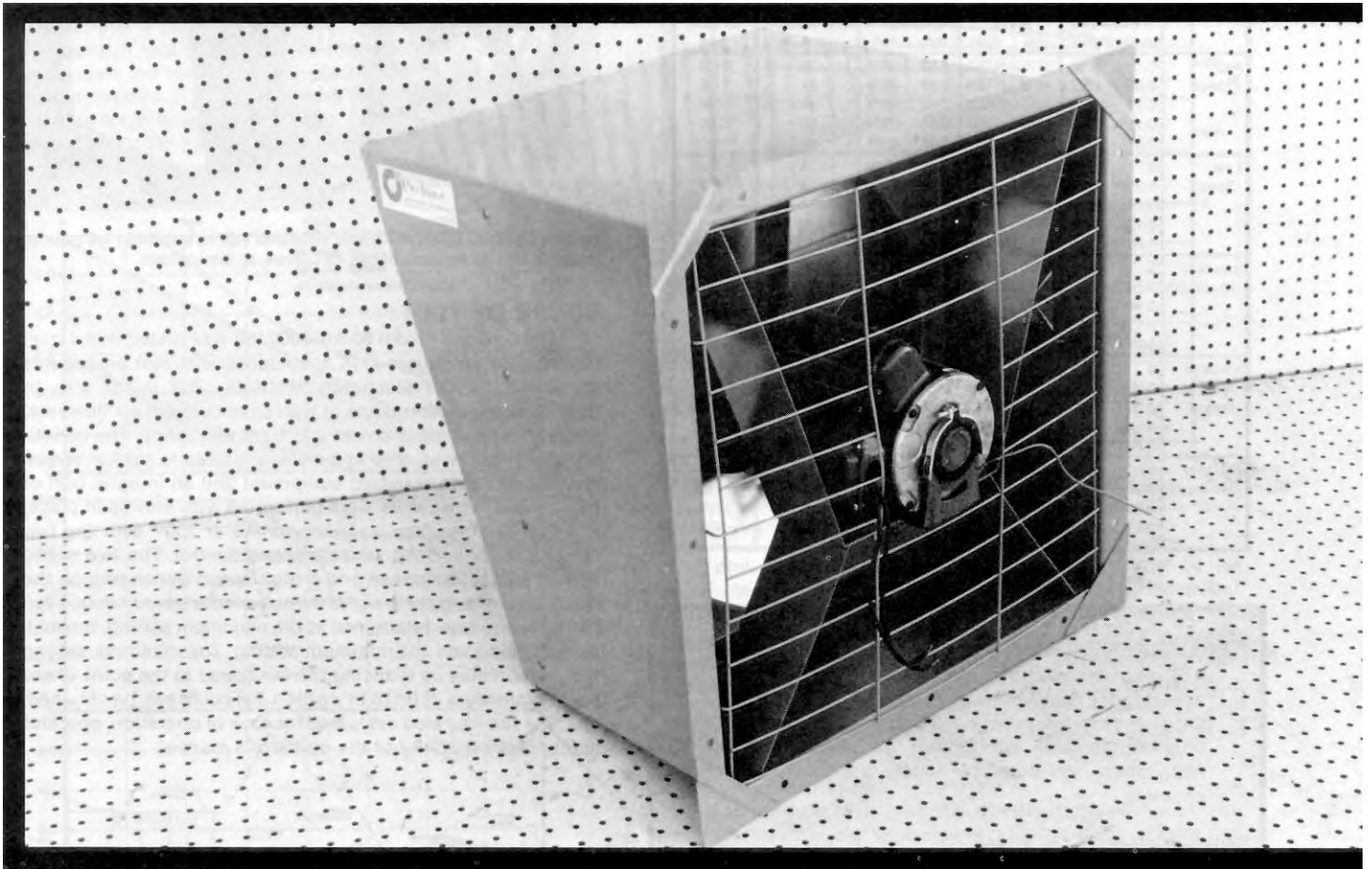


EVALUATION REPORT 378



Cyclone Model 60-AG-0000 Ventilation Fan

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

CYCLONE MODEL 60-AG-0000 VENTILATION FAN

MANUFACTURER:

Cyclone International, Inc.
694 East 40 Street
P.O. Box 1017
Holland, Michigan 49423

DISTRIBUTOR:

Walbern Agri-Systems Limited
Box 250
Linden, Alberta
T0M 1J0

RETAIL PRICE:

\$378.00 (June, 1984, f.o.b. Lethbridge, Alberta).

SUMMARY OF RESULTS

Table 1. Cyclone Model 60-AG-0000 Fan Performance at Typical Levels of Operation.

SETTING	STATIC PRESSURE in wg (Pa)	AIR FLOW RATE cfm (L/s)	INPUT POWER hp (W)	TOTAL EFFICIENCY %	FAN SPEED rpm
High Speed	0 (0)	3770 (1780)	0.60 (451)	23	1104
	0.05 (12.5)	3650 (1720)	0.61 (458)	24	1100
	0.10 (24.9)	3460 (1632)	0.63 (467)	26	1096
	0.125 (31.1)	3400 (1600)	0.63 (470)	26	1095
Low Speed	0 (0)	2370 (1120)	0.42 (310)	5	743
	0.05 (12.5)	1990 (937)	0.41 (309)	4	717
	0.10 (24.9)	1190 (562)	0.42 (311)	3	686
	0.125 (31.1)	951 (449)	0.42 (313)	2	673
Variable Maximum	0 (0)	3740 (1770)	0.59 (442)	22	1090
	0.05 (12.5)	3580 (1690)	0.60 (451)	24	1086
	0.10 (24.9)	3470 (1640)	0.61 (456)	25	1085
	0.125 (31.1)	3380 (1600)	0.62 (460)	26	1083
Variable Range	0 (0)	3214 (1520)	0.56 (418)	16	956
	0.05 (12.5)	3070 (1450)	0.57 (423)	17	949
	0.10 (24.9)	2840 (1340)	0.58 (431)	17	937
	0.125 (31.1)	2750 (1300)	0.58 (434)	17	933
Variable Minimum	0 (0)	2660 (1260)	0.51 (380)	9	794
	0.05 (12.5)	2220 (1050)	0.51 (382)	8	749
	0.10 (24.9)	1470 (694)	0.52 (385)	5	719
	0.125 (31.1)	1080 (511)	0.52 (387)	4	698

GENERAL DESCRIPTION

The Cyclone model 60-AG-0000 ventilation fan is a 17.75 in (451 mm) diameter, one speed, two speed or variable speed, direct drive, propeller type axial flow fan. It is primarily used in livestock and poultry barns as an exhaust fan located in the wall.

The Cyclone fan is a flush mounted unit equipped with an inlet guard grill, a mounting face plate, louvres, optional one or two speed control and optional variable speed control. The five aluminum blades and steel hub are mounted directly on the 0.33 hp (246 W), single phase, 230V electric motor. The housing and motor mounts are constructed of sheet metal with a protective enamel coating.

FIGURE 1 shows the location of major components while detailed specifications are given in APPENDIX I.

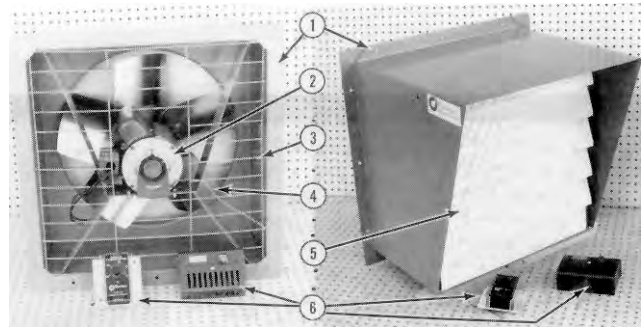


FIGURE 1. Cyclone Model 60-AG-0000 Ventilation Fan: (1) Mounting Face Plate, (2) Motor, (3) Grill, (4) Propeller Blades, (5) Louvres, (6) Control Units.

SCOPE OF TEST

The Cyclone model 60-AG-0000 fan was tested in the inlet chamber setup (Figure 2) in accordance with test procedures developed by the Machinery Institute. The intent was to determine the performance of the fan in terms of air flow rate, static pressure, input power and total efficiency. The control units were not evaluated and were only used to set fan speed. The louvres were standard equipment and an integral part of the fan unit, so all tests were performed with louvres in place.

Fan performance was determined at 230V with the two speed control and the variable speed control. The two speed control had a low speed and a high speed depending on the temperature range setting. With the variable speed control, fan performance was determined at the maximum setting, the mid-range setting and the minimum setting. The minimum setting was established by reducing the fan speed to the point where a static pressure of 0.125 in wg (31.1 Pa) could still be obtained.

The fan was also evaluated for ease of operation, operator safety and suitability of the operator's manual.

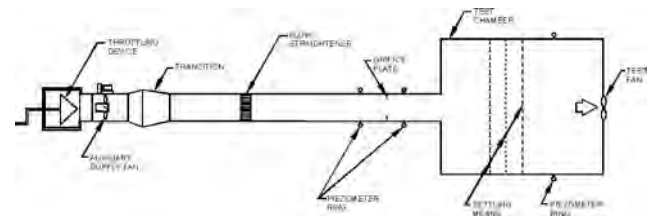


FIGURE 2. Schematic of Fan Test Apparatus - Inlet Chamber Setup.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Applying for CSA approval of the fan unit.
2. Supplying more detailed operating instructions containing illustrations and information on general operation, installation, maintenance, safety aspects and trouble shooting.

Senior Engineer: E. H. Wiens

Project Engineer: R. P. Atkins

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The fan motor, which is the critical part from a safety standpoint, is CSA approved. To get CSA approval on the complete fan unit could raise the price beyond what is economical. The fan structure has been approved by American safety people.
2. Installation instructions for other than the motor connection are included with the controls. A customer might buy from one to forty units, at which time he would receive plans, opening sizes, etc., to help him with his installation.

RESULTS AND DISCUSSIONS

FAN PERFORMANCE

All fan performance results in this report are given at standard air¹ conditions so that direct comparisons can be made with other fan test reports. Fan performance under actual operating conditions could differ from these results by up to 10%, depending on such things as temperature, barometric pressure, humidity and elevation above sea level.

¹Standard air is air with a density of 0.075 lbm/ft³ (1.2 kg/m³) which occurs at 68°F (20°C), 50% relative humidity and a barometric pressure of 29.92 in Hg (101.325 kPa).

Air Flow Rate: Fan output in both the high speed mode and at the maximum setting on the variable speed control were similar (FIGURES 3 & 4). Reducing the fan speed, greatly reduced the air flow rate for a given static pressure². For example, at a static pressure of 0.125 in wg (31.1 Pa), reducing the speed from high speed to low speed, reduced the air flow rate from 3400 to 951 cfm (1600 to 449 L/s). Similarly, at a static pressure of 0.125 in wg (31.1 Pa), reducing the speed from maximum to mid-range to minimum settings on the variable speed control, reduced the air flow rates from 3380 cfm (1600 L/s) to 2750 cfm (1300 L/s) to 1080 cfm (511 L/s) respectively. At high static pressures reductions were even larger.

Air flow rates at typical levels of operation (i.e. static pressure) are given in TABLE 1. Livestock building ventilation fans are often rated on their output at a static pressure of 0.125 in wg (31.1 Pa). The manufacturer's rated air flow rate at 0.125 in wg (31.1 Pa) at high speed was 3220 cfm (1520 L/s). PAMI's measured flow rate at the same static pressure was 3400 cfm (1600 L/s) or 5% higher than the manufacturer's rating. The manufacturer's results were not converted to standard air conditions. If this was done, the manufacturer's and PAMI's results were the same. The manufacturer's literature provided fan performance information over a range of static pressures from 0 to 0.125 in wg (0 to 31.1 Pa). The differences in output plotted in FIGURE 3 are due to the manufacturer not converting their results to standard air conditions.

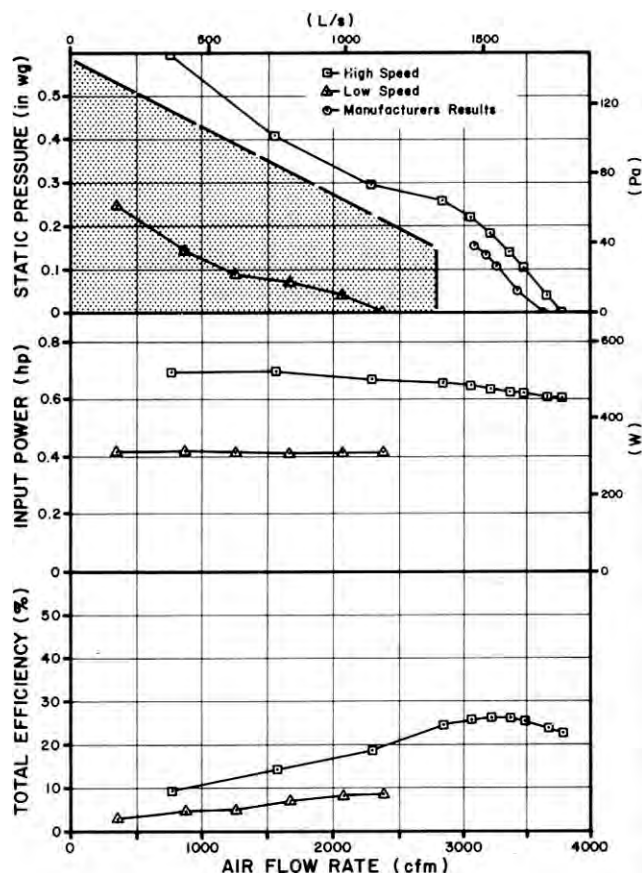


FIGURE 3. Cyclone Model 60-AG-0000 Fan Performance Curves in the Two Speed Mode.

Power Requirements: The power required to run the fan depended on fan speed and static pressure. For typical levels of static pressure (TABLE 1), the input power varied from 0.6 to 0.66 hp (451 to 489 W) at high speed, from 0.41 to 0.42 hp (309 to 313 W) at low speed, from 0.59 to 0.64 hp (418 to 467 W) at maximum speed, from 0.56 to 0.63 hp (418 to 467 W) at mid-range and from 0.51 to 0.52 hp (380 to 387 W) at minimum speed. The

²Static pressure is a measure of the pressure difference between the pressure inside the building and the pressure on the outside of the building. Static pressure is usually expressed in inches of water gauge (in wg) or Pascals (Pa).

rated amperage of the motor was 2.4 amps. The shaded zones in FIGURES 3 and 4 illustrate operation levels where the rated motor amperage was exceeded. Current draw up to 2.65 amps occurred at high static pressures. Prolonged operation in excess of the rated amperage will reduce motor life.

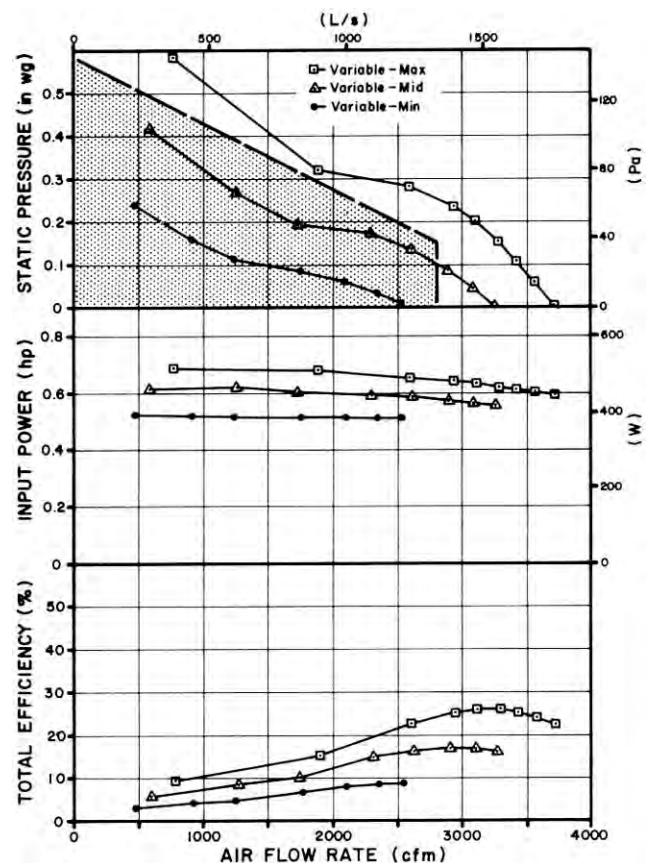


FIGURE 4. Cyclone Model 60-AG-0000 Fan Performance Curves at Three Speed Settings in the Variable Speed Mode.

Total Efficiency: Total efficiency is the ratio of air horsepower over the input power. Air horsepower is dependent upon the air flow rate and corresponding total pressure. For typical levels of operation, the total efficiency (TABLE 1) ranged from 23 to 26% at high speed, from 1 to 5% at low speed, from 22 to 26% at maximum speed, from 8 to 17% at mid-range and from 4 to 9% at minimum speed. The total efficiency at high speed and a static pressure of 0.125 in wg (31.1 Pa) was 26%.

EASE OF OPERATION

Maintenance: No maintenance instructions were supplied. The removeable inlet guard grill allowed easy access for cleaning of the housing and aluminum fan blades. Regularly scheduled cleaning and maintenance will ensure longer motor life and optimum performance.

OPERATOR SAFETY

The inlet guard grill provided adequate protection from the fan blades. Although the motor was CSA approved, the fan and motor combination were not. It is recommended that the manufacturer consider applying for CSA approval.

The noise level³ of the Cyclone fan, at a distance of 4.9 ft (1.5 m) from the centre of the fan discharge, while operating at a 0.125 in wg (31.1 Pa) static pressure, was 70 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Cyclone fan falls within range 3 of the PAMI noise level range classification (APPENDIX II). The noise level produced by this fan can be considered annoying and be

³PAMI Test Procedure for Determining Fan Noise Level.

detrimental to hearing and operator performance under continuous exposure. Ear protection should be considered if working near the fan for prolonged periods.

OPERATOR'S MANUAL

There was no operator's manual supplied. It is recommended that the manufacturer supply a detailed manual containing illustrations and information on general operation, installation, maintenance, rated performance, safety aspects and trouble shooting.

APPENDIX III	
CONVERSION TABLE	
cubic feet/minute (cfm) x 0.472	= litres/second (L/s)
horsepower (hp) x 745.7	= watts (W)
inches (in) x 25.4	= millimetres (mm)
inches water gauge (in wg) x 249.1	= pascals (Pa)
pounds (lb) x 0.45	= kilograms (kg)

APPENDIX I	
SPECIFICATIONS	
MAKE:	Cyclone
MODEL:	60-AG-0000
MANUFACTURER:	Cyclone International, Inc. 694 East 40 Street P.O. Box 1017 Holland, Michigan 49423
OVERALL DIMENSIONS:	
- housing & flange width	24.5 in (622 mm)
- housing & flange height	24.75 in (629 mm)
- housing depth at bottom	12.4 in (315 mm)
- housing depth at top	19.1 in (486 mm)
- housing dimensions	21.5 in (546 mm) by 21.5 in (546 mm)
- orifice diameter	18.25 in (464 mm)
- guard grill dimensions	21.5 in (546 mm) by 21.5 in (546 mm)
- grill opening	0.125 in (3 mm) diameter wire in a 6.75 in (171 mm) by 1.75 in (44 mm) grid pattern
PROPELLER:	
- diameter	17.75 in (451 mm)
- hub diameter	3.5 in (89 mm)
- number of blades	5
- blade angle	40°
WEIGHT:	63.2 lb (28.7 kg)
MOTOR NAMEPLATE DATA:	
- make	General Electric
- model	5KCP 39PGC5515
- class	B
- duty	continuous air over
- rpm	1075
- volts	230
- amps	2.4 amps
- phase	1
- cycles	60 Hz
- horsepower	0.33 hp (246 W)

APPENDIX II		
NOISE LEVEL RANGES		
RANGE	SOUND LEVEL (dBA)	COMMENTS
1	up to 45	Tolerable, low level background noise.
2	45 to 60	Dominating background noise that would interfere with normal conversation.
3	60 to 85	Could be annoying and be detrimental to hearing and operator performance under long-term continuous exposure. Ear protection should be considered.
4	over 85	Could damage hearing, depending on level and exposure time. Ear protection is definitely recommended.

SUMMARY CHART	
CYCLONE MODEL 60.AG-0000 VENTILATION FAN	
RETAIL PRICE:	\$378.00 (June, 1984, f.o.b. Lethbridge)
FAN DESCRIPTION:	17.75 in (451 mm) propeller fan, one speed, two speed or variable speed, direct drive, 0.33 hp (246 W) electric motor
FAN SPEED:	- two speed 646 to 743 rpm or 1088 to 1104 rpm - variable speed 698 to 1090 rpm
EFFICIENCY RANGE:	- two speed 1 to 26% - variable speed 4 to 26%
EFFICIENCY AT 0.125 in wg (31.1 Pa):	- high speed 26%
AIR FLOW RATE:	- range 298 to 3770 cfm (141 to 1780 L/s) - at 0.125 in wg (31.1 Pa) 3400 cfm (1600 L/s) at high speed
INPUT POWER:	0.41 to 0.66 hp (309 to 489 W)
OPERATOR SAFETY:	inlet guard provided no CSA approval of fan unit noise level = 70 dB(A) at 4.9 ft (1.5 m) from fan discharge
OPERATOR'S MANUAL:	none supplied



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